Open Literature Review Summary

Chemical Name: Imidacloprid

PC Code: 129099

ECOTOX Record Number and Citation:

MRID: 48371802

Nguyen, B.K., C. Saegerman, C. Pirard, J. Mignon, J. Widart, B. Thirionet, F.J. Verheggen, D. Berkvens, E. De Pauw, and E. Haubruge. 2009. Does imidacloprid seed-treated maize have an impact on honey bee mortality? J. Econ. Entomol. 102(2): 616-623.

Purpose of Review (DP Barcode or Litigation): 387496

Date of Review: 02/24/12

Summary of Study Findings:

Methods and Design:

16 apiaries were randomly selected in the southern region of Belgium, where three hives were randomly selected in each apiary. Each hive was visited every 2 months between March 2004 and March 2005. Beekeepers followed their usual apicultural methods but left the colonies in the same locations for the entire year. All maize fields within a radius of 3 km around the selected apiaries were identified and all crops flowering at the same time as the maize flowering were recorded. Each field was characterized by its surface area (S), lower (L) and upper (U) limit of distance to the apiary. All maize fields treated with imidacloprid were noted. The mortality rate in an apiary was defined as the number of dead colonies (no live bees) divided by the total number of colonies in the apiary multiplied by 100.

Honey, beeswax, and bee samples were collected from the three chosen hives per apiary. These samples were analyzed for pesticide residues, including imidacloprid. Maize flowering occurred in August. Pollen was collected from cells in the hives, and presence of maize pollen was confirmed by microscopy. Two grams of honey were randomly sampled from each colony, 25 cm^2 of randomly selected food-free beeswax, and 20 honeybees (10 workers in the hive and 10 at the entrance) were sampled in each selected hive. All samples were stored at -20C before residue analysis. Half of the samples were run using GC MS/MS and the other half with LC MS/MS.

Results:

Maize fields treated with imidacloprid represented 13.2% of the total maize area. Imidacloprid treated fields covered between 0.05% and 2.48% of the maximum foraging area studied. The surface coverage of untreated maize ranged from 50.79 to 370.39 ha. No beneficial crop flowered at the same time as maize within the 3km radius assessed near each apiary.

The mortality rate ranged from 0 to 84.2%, and all colonies that died did so during the winter period (November – March), except in one apiary whose colonies died in August.

The study authors note that the majority of hives were in areas with treated maize fields. In contrast, some of the highest mortality occurred in areas where only untreated maize was encountered. While this is appears to be the case, there were detections of imidacloprid in only 2 of the 16 apiaries. These two apiaries exhibited no mortality. In fact, seven apiaries showed no mortality, so 5 out of 7 apiaries that had no mortality also had no detections of imidacloprid.

The study authors found a significant correlation between the number of colonies (ranging between 3 and 42 per apiary) per apiary and the mortality rate. The higher the number of colonies per apiary, the higher the mortality rate. The study authors also found a significant inverse correlation between the maize areas treated with imidacloprid and the mortality rates in an apiary. In addition, there was a significant inverse correlation between the total maize area and the mortality rate in the apiary except for the 1st and the 3rd scenarios (bee forage range of <1000m and <1750m, respectively). Finally, an inversely significant correlation was found between the mortality rate and the proportion of treated maize surface/total maize surface.

The study authors also conducted an analysis of pesticide residues. Nine pesticides were detected in honey, and imidacloprid was detected in four samples. Imidacloprid concentrations showed a mean level of 0.275 ppb in honey, but it was not detected in wax or bees in any apiary. The most commonly occurring pesticide was rotenone (31.3% of honey samples), which is a banned acaricide used to treat *Varroa destructor*. Only lindane was found in honey bees, and 11 pesticides were present in bee wax.

Description of Use in Document (QUAL, QUAN, INV):

Qualitative

Rationale for Use: Characterization in risk assessment

Limitations of Study:

The study explored the impact of imidacloprid on hive mortality through overwintering. The study evaluated the area of maize (both treated with imidacloprid and untreated) in relation to survival of the hives. The study authors attempt to relate the area of treated maize with hive survival to determine the impact of imidacloprid on hive survival. The study authors also try to relate the total area of maize fields with hive survival. In each case, the study authors analyzed the data based on six different foraging scenarios. These scenarios relate to a bee's foraging radius, with distances from 1,000 to 3,000 m. The study authors measured the total area under maize production and the use of imidacloprid on these fields up to a distance of 3 km. The study authors also measured how much imidacloprid entered the hives in the apiary.

There are some major uncertainties that affect the utility of the study. The study reveals that very little imidacloprid returned to the hives. Only two apiaries had detections, each in honey and each apiary was located in areas with greater than 40% imidacloprid treated maize area to total maize production area. Yet it is impossible to accurately ascertain levels of contamination in the hives as they relate to hive mortality. Maize does not

produce nectar, yet the study authors only measured residues in honey, wax, and bees, and simply related pollen loads to those measured in a previous study. The study authors effectively introduce considerable uncertainty in the conclusions of the data by the lack of sampling of the main source of potential hive contamination, i.e. bee bread and incoming pollen.

The study provides information on the mortality levels of hives located in areas with maize production. Yet the study lacks measurements on key parameters that are needed to adequately interpret the results. These measurements include imidacloprid contamination of hive pollen (measurement of exposure), in which apiaries the various other contaminants were found, a report of the level of maintenance and effort were required for each apiary, and what other sources of forage may be available for the bees near each apiary (as opposed to simply other attractive crops). While the study suggests that increasing amounts of maize area within the foraging radius of hives, regardless of contamination by imidacloprid seed treatments, was correlated with decreases in hive mortality, the study is not able to distinguish whether these results are a consequence of the hive density in each apiary, potential differences in alternative forage, or the area of maize (treated or untreated) near each apiary. Finally, the utility of the study is limited given differences in agricultural systems in the United States versus southern Belgium.

Primary Reviewer:

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